AN EXPLORATORY STUDY:
THE EFFECTS OF CHRONIC, LONG-TERM MARIJUANA USE
ON DEPTH PERCEPTION

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ABSTRACT

Twenty Ss were chosen on the basis of their age, sex family background, visual acuity, and past history of drug use, to participate in a study concerning the chronic, long-term effects of marijuana use on depth perception. An orthorater was used to measure depth perception.

The treatments consisted of a user group and a non-user group. The subjects in the user group had smoked marijuana for a minimum of seven times a week for a six year period. They abstained from marijuana use 96 hours prior to examination. The results showed a depth perception impairment for the male users ($p < .05$) with an interaction effect between drug use and sex that approached significance ($p < .10$).

CHAPTER I

INTRODUCTION

The rapid increase in the use of the drug marijuana, the most widely used psychedelic, has not been accompanied by a rapid increase in our knowledge of its effects (Grant, Rockford, Fleming & Stunkard, 1973). The year 1964 may be considered the most fruitful year in the advancement of marijuana research. During that year the major active component in cannibis, the Delta-9-1-trans tetrahydrocannabinol, was defined in structural form and its pure form was isolated (U.S., Department of Health, Education, & Welfare, 1970). Still the experimental studies of the effects of marijuana usage are few, and most have dealt with personality variables of the user (DeMeritt, 1971; McQuire & Megargee, 1974; Mitchell, 1972; Robbins & Tanck, 1973; Robinson, 1971; Tookey, 1971), or attitudes toward marijuana (Church, Truss & Martino, 1974; Colainata & Breed, 1974).

The general procedure has been to manipulate marijuana consumption in a laboratory setting using subjects with little past experience with the drug (Abel, 1971; Hollister & Gillespie, 1970; Manno, 1971; Weil, 1968). Meyer, Pillard, Shapiro, and Mirin, in 1971, however, concluded that casual smokers showed greater degrees of impairment by marijuana than heavy smokers. The current research is directed towards determining effects upon the chronic marijuana

user (Beaubrun & Knight, 1973; Kolansky & Moore, 1972; Weckowicz & Thaddeus, 1973).

Physiological correlates of marijuana use have recently been examined. One study reported that physiologically the most clear cut effects of THC were on the pulse rate (Waskow, 1970). It has been reported that the eyes were particularly sensitive to the use of marijuana and this fact has inspired an interest in visual perception correlates. Mohan and Sood (1964) claim that a survey of the medical literature revealed that the following visual effects have been noted: dilation of the pupils, blindness (temporary), swelling of the eyelids, hallucinations, congestion of the conjunctiva and lids, and finally, ulcers of the cornea.

Heavy users (those who had used marijuana every day or nearly so) and casual users (those whose use was limited to once a week or less) were administered marijuana (Meyer, Pillard, Shapiro, & Mirin, 1971) to assess the drug's effect on perceptual and psychomotor performance. The results indicated that marijuana smoking impaired performance on most all perceptual tests, but had more adverse effects on the casual users. On a continuous performance test (letters were flashed on a screen at one-second intervals and subjects pressed a key when they saw the letters), casual smokers made five times as many errors of omission under an ad lib dosage (users smoked until "high", based on a subjective evaluation) of marijuana as they did

under a placebo. No increase in the number of errors was found in the heavy users.

Dornbush, Fisk, and Freedman (1971) found no deficit in visual and auditory reaction time with a low-dosage group, but did find significant losses in these areas with higher doses. Clark and Nakashima (1968) found complex reaction time to be more sensitive to marijuana than simple reaction time. They also reported progressive deterioration of learning rate on a digit code test with increasing doese. No significant trend, however, was found using a test of depth perception (positioning vertical white rods at 16 feet).

Berger (1972) used tachistoscopic presentations of visual materials to measure immediate memory and the Howard-Dolman apparatus for depth perception with subjects under marijuana intoxication. She concluded that marijuana affected the acquisition of new materials but not immediate memory. Depth perception scores were impaired by marijuana and the impairment lasted longer than did a similar impairment of a group of subjects under the influence of alcohol.

In the present study, the effects of chronic, long-term use of marijuana on depth perception were examined. It was an exploratory study in that the cumulative effects of marijuana usage, not the state of marijuana intoxication, were studied. A non-user group and users who had smoked marijuana over a six year period at least

seven times a week, were tested for depth perception on a orthorater. The users abstained from marijuana 96 hours prior to examination.

CHAPTER II

METHOD

Subjects. Twenty subjects were chosen, ten of whom had never smoked marijuana and ten of whom were regular users. The latter ten subjects smoked marijuana for six years, at least seven times a week on the average. Five male and five female subjects were used in both the non-user and user groups.

All subjects were between the ages of 20 and 30, with a mean age of 24 years, nine months. Every subject had at least a high school education, and approximately half had attended some college. All came from middle or upper-middle class families which were still intact, and no subject was an only child. None had a previous history of psychiatric disorder.

The subjects were carefully screened regarding their previous use of drugs before participating in the experiment. This information was obtained in private, individual interviews. Cooperation was received in all cases after a statement of confidentiality was given. Subjects who had used alcohol during the previous six years were retained if their alcohol use was limited to social drinking. Social drinking was defined as reaching intoxication from alcohol less than once a week over the time period.

Subjects in the control group had not used any amphetamines, hallucinogens, or other mind-altering, non-prescription drugs. Some subjects in the experimental group had infrequently taken such drugs, but were limited to no more than two doses during a one month period in two consecutive months for the six years. Approximately half of the users had not indulged beyond alcohol and marijuana.

All subjects in both groups reported social use of alcohol, and no attempt was made to alter their routine alcohol intake. The subjects were tested for binocular visual acuity with an orthorater (Lafayette Instrument Company). Those who wore glasses were asked to wear them during examination. Only those subjects with acuity ratings between 20/17 and 20/25 on the Snellen scale were used. One male user was eliminated due to a Snellen rating of 20/40.

The subjects in the experimental group were requested to refrain from marijuana or other drug use (with the exception of alcohol) for four days prior to examination. All experimental subjects stated that they had abstained as requested for the 96 hour period.

Apparatus. An orthorater (Lafayette Instrument Company) was used to measure depth perception. This apparatus measures depth perception in terms of stereoscopic acuity or the ability to judge distances. A slide is projected which presents a distance target with certain details. These details are optically located closer to the eyes of the viewer. The slides covers a large range with

the most difficult level located less than one and one-half inches before the distance target plane.

Depth is accomplished by accurate variations of the distance between target details on the two sides of the slide. Each subject was presented nine steps of progressive difficulty. The number of correct responses prior to two consecutive incorrect responses was used to convert to the stereopsis angles and Fry-Shepard percentages.

Procedure. All subjects were brought into a typical classroom setting and instructed according to the procedure set forth in the orthorater's scoring manual. They were first presented with the slide for determining visual acuity (slide F-3), followed by the slide for depth perception (slide F-6). All subjects viewed the same two slides listed above.

After the slide presentation with the orthorater, each subject was asked about his age, education level, family background, and drug use. The subjects in the experimental group were asked about the 96 hour abstention from marijuana at that time. All subjects were asked the same questions except for the last question which was asked of the experimental subjects only.

CHAPTER III

RESULTS

The subjects tolerated the procedure well and were able to complete the experimental task to measure depth perception. Because extreme positive skewness was present in the data, a square root transformation was applied to all raw scores. The transformation is nonlinear and tends to pull the more extreme scores in toward the mean. It was deemed justificable because the skewness was a natural occurrence.

The Fry-Shepard Scale was used for statistical computation to account for the random occurrence of three depth perception scores of zero. A high score within this scale reflects increased depth perception, while a low stereopsis angle is indicative of increased depth perception. Table 1 (p. 9) presents the raw scores for both scales along with their square root equivalents.

A 2x2 analysis of variance was performed. Comparison of the depth perception scores of the user and non-user groups alone showed little difference between them. Consideration of the interaction between the sex of the subject and his drug use revealed mild impairments, while the male users displayed substantial depth perception impairment. Figure 1 (p. 10) illustrates the sex difference based on the mean Fry-Shepard scores.

TABLE I

Raw Scores and Square Root Transformations

for Experimental and Control Groups

		NON-USERS					USERS			
		SA	FS	SR			SA	FS	SR	
				SA	FS				SA	FS
MALES	1	19"	96.0%	4.35	9.79	1	0"	0%	0	0
	2	0"	0%	0	0	2	32"	84.4%	5.65	9.40
	3	27"	88.5%	5.19	9.40	3	362"	17.8%	19.02	4.21
	4	9.7"	106.5%	3.11	10.31	4	362"	17.8%	19.02	4.21
	5	9.7"	106.5%	3.11	10.31	5	0"	0%	0	0
FEMALES	1	19"	96.0%	4.35	9.79	1	32"	84.4%	5.65	9.4
	2	43"	76.5%	6.55	8.74	2	12"	103.6%	3.46	10.17
	3	362"	17.8%	19.02	4.21	3	27"	88.5%	5.19	9.4
	4	43"	76.5%	6.55	8.74	4	43"	76.5%	6.55	8.74
	5	27"	88.5%	5.19	9.40	5	9.7"	106.5%	3.11	10.31

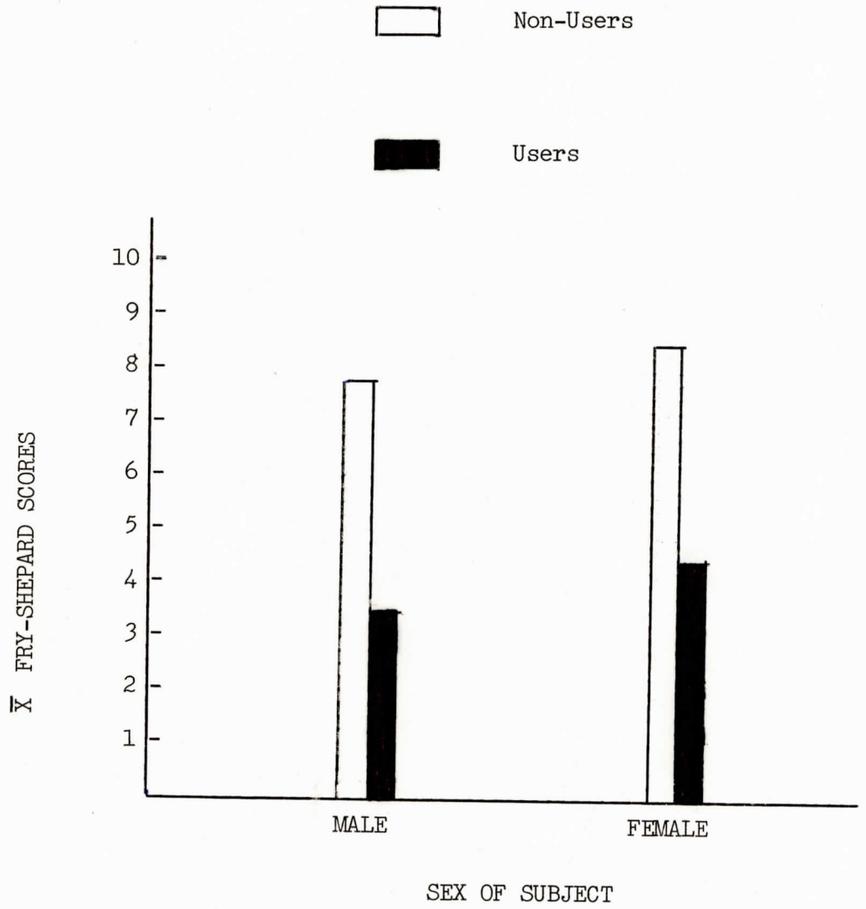
SA Stereopsis Angle

FS Fry-Shepard

SR Square Root Transformation

FIGURE I

Comparison of Results on Depth Perception



The scores of the male users were least variable, while the standard deviation of the other groups were higher and similar. The means of the user groups, including both male and female subjects, were similar to the non-users. There was considerable difference between the means of the male and female subjects. Table 2 (p. 12) presents this descriptive data and Table 3 (p. 13) gives corresponding significance levels.

Comparison of means between the user and non-user groups yielded a t-value of .88, which was not significant. The t-value between the means scores of males and females, however, was 2.02, significant at the .10 level. The t-value between the means scores of male users and male non-users was highly significant ($t = 3.33$, $df = 8$, $p < .02$).

The interaction between chronic, long-term marijuana use and the sex of the user approached significance ($F = 4.83$, $df = 1/19$, $P < .05$). It appeared that marijuana use may have impaired the depth perception of the male users. Table 4 (p. 14) presents summary data for the analysis of variance operation.

TABLE 2

Means and Standard Deviation based on

Fry-Shepard Percentages for Experimental and Control Groups

		s.d.	$\bar{X}$
Experimental Group	MALE	2.38	3.56
	FEMALE	4.28	4.79
Control Group	MALE	4.09	7.96
	FEMALE	3.78	8.33

TABLE 3

Results of the T-Test

Conditions	t-values	t-values needed for p .05 level of significance
User vs. Non-Users	.88	2.10
Male vs. Female	2.02	2.10*
Female User vs. Female Non-User	.93	2.31
Male User vs. Male Non-User	3.33	2.31**

* p .10

** p .02

TABLE 4

Analysis of Variance for Experimental and Control Groups

SOURCE	SS	df	MS	F	p
Total	264.44	19	13.90	-	-
SS_{MF}	48.92	1	48.92	4.83	.05
SS_{U-NU}	11.01	1	11.01	1.87	n.s.
$SS_{MFxU-NU}$	42.47	1	42.47	4.19	.10
Error	162.04	16	10.13	-	-

M = Male

F = Female

U-NU = User - Non-User

CHAPTER IV

DISCUSSION

It is difficult to generalize from the findings of an exploratory study, and with the illegality and controversy surrounding marijuana use, any generalization must be viewed with skepticism. There is inconsistent data concerning the effects of marijuana on depth perception. The primary purpose of the present investigation was to concentrate on the possibility of a depth perception impairment due to long-term marijuana use. The results tend to support this conclusion and there were significant effects ($p < .05$) found in the male user group.

This conclusion was in line with the findings of Berger (1972). She tested for deficits, however, with the subjects under the influence of marijuana intoxication. All of her subjects were male as were the subjects in the majority of the studies examined. The present study gave evidence for the future consideration of the sex of the user, as well as his past history of drug use.

Because of the consideration of long-term usage, the present investigation was forced to rely on retrospective reports from users. A longitudinal study could possibly eliminate subjective

data by controlling the levels of Delta-1-THC ingested by the habituated user. Other drug usage, including use of alcohol was not eliminated, and this may have confounded the data.

Grant, et al. (1973) and his fellow associates were able to group separately subjects who used only marijuana and those who had used additional drugs. They found no difference between these subgroups of marijuana smokers. Further investigation is needed to determine the interaction effect of hallucinogenic drugs. More knowledge is needed of marijuana's behavioral toxicity in order to judge the risks to the user and those in his environment. The raw scores from this investigation were presented in the hope that future investigators could combine them with the scores from similar subjects in arriving at some trend.

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